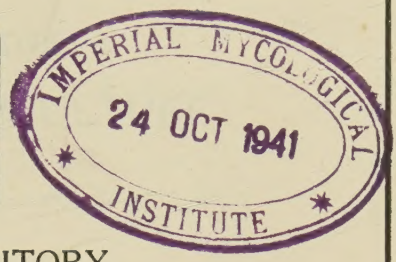
(*Pamphlet No. 28*)



TANGANYIKA TERRITORY

DEPARTMENT OF AGRICULTURE

Seventh Annual Report of the Coffee Research and Experiment Station, Lyamungu, Moshi 1940

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COFFEE RESEARCH AND EXPERIMENT STATION, LYAMUNGU, MOSHI

Report for the period 1st January to 31st December, 1940

ADMINISTRATION

Staff List in January, 1940

Chief Scientific Officer in general charge.—S. M. Gilbert, B.SC., N.D.A., DIP.AGRIC. (WYE).

Plant Pathologist.—G. B. Wallace, B.SC., PH.D. (EDIN).

Entomologist.—F. B. Notley, M.SC., A.I.C.T.A.

Chemist.—H. B. Stent, M.SC., A.I.C., A.I.C.T.A.

Agricultural Officer.—Vacant.

Agricultural Assistant.—L. M. Fernie (Plant Propagator).

European Clerk.—Vacant.

Experiment Surveyor.—I. Thomson.

Senior Recorders.—K. Johansen (serving with Forces) and J. C. van Schoor. Two vacancies.

Staff Changes

The Chief Scientific Officer and Chemist returned from vacation leave in February and March respectively. As an emergency measure the duties of Agricultural Officer continued to be carried out by Mr Milne, Soil Chemist, Amani, until the 24th February. Thereafter the appointment was left vacant. Messrs Notley, Stent, Fernie, Thomson and van Schoor were released for military service in June and all volunteered and joined the Kenya Regiment. The Chief Scientific Officer and Plant Pathologist alone of the European staff are left to continue the work of the station, the services of the Plant Pathologist now being available for general duties.

Finance

Financial assistance amounting to £3,750 was again provided from the Colonial Development Fund. Large savings on expenditure on the station were effected by the release of officers to the colours and by leaving several posts vacant. Details of expenditure are given in Appendix I.

Revenue amounted to £270, plus £12-13 the value of beans used in labourers' rations.

Publications

The publication of *Quarterly Notes* ceased with the June number. It will not be possible to re-issue this periodical until after the war.

Station Development

In spite of difficulties the planting of some vital experiments has been completed and continued development is reflected in the following table :—

Table I

How occupied	Acres		Change
Coffee:—			
(a) under three years	38		
(b) over three years	36	+	10
Nurseries	4	—	3
Bananas and fodder grasses	26	+	6
Paddocks	20	+	6
Coppice and wind belts	26		
In preparation for experiments	32	—	18
Forest	30		
Roads, buildings, etc.	27		
Bush—uncleared	43	—	1
Food gardens for labourers	28		
Total ...	310		

Much of the area under coffee over three years of age consists of species other than arabica, forming a comprehensive collection of some twenty species and nearly a hundred varieties and types of coffee. A further large area is for use in "stock" trials. Thus the yield of five tons of parchment coffee obtained this year is from about twenty acres.

Meteorology.

Table II

Meteorological Summary for the year ended 31st December, 1940

	Mean Maximum °C	Mean Minimum °C	Humidity 8·30 a.m. per cent	Humidity 2·30 p.m. per cent	Sunshine hours	Rainfall milimetres
January	28·1	14·8	80	56	177	71·8
February	29·2	14·6	78	52	192	133·9
March	26·1	15·5	89	71	157	104·7
April	23·7	15·8	93	78	81	549·5
May	22·3	15·6	92	75	61	305·9
June	21·4	13·9	89	67	116	68·1
July	20·6	13·4	91	66	91	51·8
August	21·9	13·3	90	58	113	65·4
September	24·2	12·6	87	51	142	8·4
October	26·5	13·4	87	50	174	26·2
November	27·9	13·9	89	50	191	23·0
December	28·8	14·4	84	53	212	27·3

The total rainfall for the year was 1,436·0 millimetres (56·5 inches). The year was again noteworthy for the failure of the short rains.

Vegetative Propagation

Cuttings of coffee have been rooted on a large scale for two successive years. These cuttings were taken from unselected seedling plants trained for that purpose by pegging down several upright stems and are being used in precise experiments on this station.

In the case of selections the position has been difficult. On heavy yielding trees, on single stem growth, material suitable for cuttings is rare. To increase

Note.—Owing to the curtailment of research, due to the large reduction in staff, Sections II, III, IV, V and VII have been omitted. A general review of the year's work, more full than in previous years, is substituted. Section VI (Plant Pathologist's report) is attached as an appendix.

such material it would have been necessary to prune each tree to an extent which would have seriously and adversely affected its yield. Since yields had to be recorded over a period of years (at least six) before a tree could be accepted as a heavy bearer such pruning could not be done. Rooted cuttings of selections have therefore been slow in accumulating. At the end of 1940 twelve trees are represented in the nursery by more than twelve rooted cuttings and about a hundred others have a lesser number. The point is that these trees are now growing especially for obtaining cuttings and progress from this date will be much more rapid. The position is approximately that of the experiment material three years ago. That is to say mass production of cuttings of selected trees should begin in 1942 and will then be available for field trials in various districts.

The work of training personnel in budding and grafting continues. Cleft grafting can be carried out fairly easily.

Improvement of Plant Material

The work of recording cherry yields of potential selections for the year, on various estates, has been completed. Records are now available for a hundred high yielding trees for seven years and for a further fifty trees for four years. In addition, fifteen trees on station plots have been selected provisionally and the records of these are known for three years. It was not possible to sample and study further characteristics of any selections for this year.

Cultural and Manurial Investigations

On estates and native holdings.—It may be opportune at this time to review the position as to co-operative experiments on estates and native holdings. At the peak period fifty-three experiments were in hand. Of these twelve have had to be abandoned due to reasons beyond our control, such as deaths of owners and planters giving up coffee production, the latter mostly on marginal lands. Eleven were on enemy alien estates. Some of these are now on yearly leases; others are worked by the Department of the Custodian of Enemy Property. In both groups the difficulties of continuing the experiments are well nigh insurmountable; briefly because funds are not forthcoming from any source. Eight further estates are owned by Greeks with whom co-operation is very good. Of the remainder eleven are British and eleven African. About half of these are uniformity trials which, in normal times, would have had treatments applied in 1939. This work cannot be begun. From the above it is seen that co-operative experiments have suffered considerably. Even so the proportion of experiments still in hand to those originally started is well up to that found in the experience of other countries.

Records of yields have been obtained from all the estates still being carried on but studies of "out-turns" have not been done.

Summaries of results from co-operative experiments are given below.

Although some of the experiments have not fully satisfied the tests for significance, it may fairly be inferred that, in general, sulphate of ammonia has given useful increases in yield on the estates on which the treatment was included. The amount when used alone was half a pound per tree.

As was to be expected in a year in which short rains again failed mulch gave appreciable returns in two out of three cases (Estates E and F).

Estate B.—Summary of Results—1940

Mean yield	Nil	Sulphate of ammonia (a)	Compost (b)	Half each of (a) & (b)	Mean	Standard error	Sig. dif. P=·05
Clean cwt. per acre ...	14·4	13·9	15·3	19·2	15·7	0·11	0·39
Percentage	91·7	88·5	97·5	122·3	100·0	0·70	2·5

Yearly mean yield—1937 to 1940

							P=·05
Clean cwt. per acre ...	6·0	7·6	6·8	7·1	6·9	0·29	1·03
Percentage	87·0	110·1	98·6	102·9	100·0	4·2	14·9

Compost has been outstandingly successful in 1940 in combination with sulphate of ammonia. A mean increase of 1·6 cwt. or 23 per cent has been obtained by sulphate of ammonia over the whole period of four years.

Estate F.—Summary of Results—1940

Mean yield	Nil	Sulphate of ammonia	Pen Manure	Mulch	Mean	Standard error	Sig. dif.*
Clean cwt. per acre ...	8·97	11·21	12·44	11·70	11·08	·23	—
Percentage	80·6	101·2	112·3	105·2	100·0	2·1	—

*Does not pass Z test.

Yearly mean yield—1936 to 1940

							P=·05
Clean cwt. mean per acre	2·99	4·05	3·89	3·84	3·70	·06	·20
Percentage	80·7	110·6	105·0	103·7	100·0	1·5	5·3

In 1940 pen manure has done well. Plots have responded well to all treatments over the period, with sulphate of ammonia best, giving an increase over control plots of thirty per cent.

Estate L.—Summary of Results—1940

Mean yield	Nil	Sulphate of ammonia†	Pen manure	Banana Mulch	Mean	Standard error	Sig. dif.
Clean cwt. per acre ...	6·0	7·4	6·7	5·7	6·5	0·17	—
Percentage	92·3	113·9	103·1	87·7	100·0	2·6	—

†In 1940 only Urea was applied instead of Sulphate of ammonia. Urea appears to have given a useful increase amounting to 20·6 per cent over no treatments, but the experiment does not pass Z test for P=·05.

Estate E.—Summary of Results—1940

Mean yield	Nil	Pen Manure	Thatching grass	Guinea grass	Mean	Standard error	Sig. dif.*
Clean cwt. per acre ...	10·82	8·74	12·70	13·42	11·42	·13	—
Percentage	94·7	76·5	111·1	117·5	100·0	1·14	—

*Nearly significant for P=·05.

Mean of five years—1936 to 1940

Clean cwt. mean per acre	4·4	4·4	5·2	4·5	4·6	·04	·14*
Percentage	94·6	94·6	112·4	97·8	100·0	1·12	3·88

*Nearly significant for P=·05.

Results confirm those of previous years for thatching grass. Those for guinea grass are a substantial increase. Thatching grass used as mulch has given consistently good results, i.e., a mean increase per annum of nearly twenty per cent over no treatment plots.

Estate AN.—Summary of Results—1940

Mean yield	Nil	Sulphate of ammonia (a)	Pen Manure (b)	Half each of (a) & (b)	Mean	Standard error	Sig. dif.*
Clean cwt. per acre	9·5	11·3	9·4	10·8	10·2	0·62	2·75
Percentage ...	93·1	110·8	92·2	105·9	100·0	6·1	27·0

*Not quite significant for P = ·05.

It will be noted that sulphate of ammonia has been effective this season, giving an increase of nearly eighteen per cent over no treatment plots. The effect could also be seen in the trees themselves.

Estate AP.—Summary of Results—1940

Mean yield	Nil	Sulphate of ammonia (a)	Pen Manure (b)	Half each of (a) & (b)	Mean	Standard error	Sig. dif.*
Clean cwt. per acre ...	5·5	6·6	5·7	6·5	6·1	0·38	1·6
Percentage	90·2	108·2	93·4	106·6	100·0	6·3	26·2

*Nearly significant for P = ·05.

The increase per cent in yield in this experiment of sulphate of ammonia plots over no treatments is eighteen. In this particular season the artificials have had most effect.

Estate AQ.—Summary of Results—1940

Mean yield	Nil	Sulphate of ammonia (a)	Pen Manure (b)	Half each of (a) & (b)	Mean	Standard error	Sig. dif. P = ·01
Clean cwt. per acre ...	3·7	5·0	3·9	5·1	4·4	0·23	0·88
Percentage	84·1	113·2	88·6	115·9	100·0	5·2	20·0

Plots receiving sulphate of ammonia have given increases of the order of thirty per cent.

Estate AR.—Summary of Results—1940

Mean yield	Nil	Sulphate of ammonia (a)	Pen Manure (b)	Half each of (a) & (b)	Mean	Standard error	Sig. dif.*
Clean cwt. per acre ...	3·4	3·8	3·4	3·5	3·5	0·15	—
Percentage	97·1	108·6	97·1	100·0	100·0	0·01	—

*Only passes Z test for P = ·2.

Sulphate of ammonia has given an increase of 11·5 per cent in this season.

Estate AJ.—Summary of Results—1940

Mean yield	Nil	Sulphate of ammonia (a)	Pen Manure (b)	Half each of (a) & (b)	Mean	Standard error	Sig. dif. P = ·01
Clean cwt. per acre ...	4·0	4·7	4·1	5·0	4·5	0·08	0·33
Percentage	88·9	104·4	91·1	111·1	100·0	1·6	7·33

Sulphate of ammonia has given substantial increases this season, both alone and with pen manure. It is clear from plots with pen manure alone that it is the artificials causing the increase. It amounts to twenty-two per cent in the plots having combined sulphate of ammonia and pen manure.

Estate AK.—Summary of Results—1940

Mean yield	Nil	Sulphate of ammonia (a)	Pen Manure (b)	Half each of (a) & (b)	Mean	Standard error	Sig. dif.
Clean cwt. per acre ...	9·73	9·35	10·24	9·21	9·64	·41	—
Percentage	100·9	97·0	106·2	95·5	100·0	4·3	—

Treatments have given no significant differences. This experiment is located in a very rich area in the Uru valley.

Estate A L.—Summary of Results—1940

Mean yield	Nil	Sulphate of ammonia (a)	Pen Manure (b)	Half each of (a) & (b)	Mean	Standard error	Sig. dif.
Clean cwt. per acre ...	·04	·04	·06	·05	·05	·005	·013
Percentage	80·0	80·0	120·0	100·0	100·0	9·4	26·0

Unfortunately this experiment which showed great promise was severely damaged without consulting this station by cutting off the primaries with a view to planting maize.

It should be noted in connection with the results given above that much more information is contained in the records of the past few years such as the interactions between seasons, localities and treatments but it is not possible to analyse these data with the present staff. Further, it is imperative that changes in the soil due to treatments should be followed, but, in the absence of the Chemist, this cannot be done. Under present circumstances it is considered best to continue the collection of records anticipating provision for their proper examination later.

EXPERIMENTS ON STATION

Among the most important factors affecting yields of coffee are the distribution and amount of rainfall. These factors are important in most of the coffee producing areas of Tanganyika Territory. At Lyamungu, for example, total rainfall has varied annually between extremes of 46 inches and 101 inches. Distribution is similarly irregular. The short rains, which in 1935 amounted to some eight inches, failed entirely in 1939 and 1940. In the long rains as much as eighty inches fell in 1937 and only thirty inches in 1934. These figures are sufficient to show the extreme variation. Thus mean annual rainfall in itself is a figure of little value. It follows that treatments which are effective in wet years may not, and usually do not, cause similar responses in dry years. A period of years is therefore necessary before reliable deductions can be made from field experiments. A study of the results in previous reports and of those given above shows clear indications of the benefits of certain treatments under varying amounts of rainfall and of distribution. Briefly, readily available nitrogen such as sulphate of ammonia has given considerable increases in years of heavy "long" rains. Mulches have consistently improved yields when the conditions in the last six months of the year have been dry. These single factor experiments on estates, carried out on very variable seedling trees, have had a useful preliminary value. It is clearly desirable, however, that the precise effects should be known of combinations of factors and their inter-relationship. With the mass production of clonal* material and further knowledge of the technique for carrying out complex field experiments it has been possible to lay down a set of experiments on the station which will go a long way in settling the problems mentioned above.

The following is a brief description :—

Experiment XIV A.—To compare the merits of guinea grass, elephant grass and banana trash, applied as mulches, with compost made from equivalent amounts of elephant grass and with clean cultivation. To study the effect of sulphate of ammonia in combination with these treatments. The lay-out is a 5 × 5 latin square with split plots for nitrogen and is under shade (contrasting with experiment XIV—no shade).

*A variety propagated asexually from a single original individual is called a clone.

Experiment V.—To compare the effects of three levels of nitrogen (sulphate of ammonia), three of compost and three of elephant grass mulch and their interactions. The lay-out is a $3 \times 3 \times 3$ design in blocks of nine plots. There are three blocks in each of four replications. There is no shade.

Experiment VI.—To compare the effects of three amounts of nitrogen, three kinds of nitrogen (acid, alkaline and organic) and three times of application. The lay-out is a $3 \times 3 \times 3$ design in a 9×9 quasi-latin square. There is shade.

Experiment XV.—To compare the effects on four clones of four levels of irrigation with four levels of banana trash mulch and the interactions between treatments. The lay-out is an 8×8 half plaid square. There is no shade.

The above experiments, with the exception of VI, to be planted in 1941, were planted in 1940 long rains with rooted cuttings. It will be seen that between them they cover the main problems of nitrogen, with and without shade, mulch, compost, irrigation and the relations between them.

The following tables give results of experiments on the station :—

Experiment I.—Method of Planting

(a) *Main plots*

	Mean Yield	
	Clean cwt. per acre	Percentage
No Holing	5·08 ...	90·4
*H3F1	6·85 ...	121·9
†HF1	5·35 ...	95·2
Hole Subsoiled :		
Without Compost, H3F1 ...	6·51 ...	115·8
„ „ HF1 ...	5·46 ...	97·2
With Compost, H3F1 ...	5·83 ...	103·7
„ „ HF1 ...	4·26 ...	75·8
Mean	5·62 ...	100·0
Standard error	·08 ...	1·40
Significant Difference, P=·01 ...	·295 ...	5·30

*H3F1 = Holed three months and filled one month before planting.
†HF1 = Holed and refilled one month before planting.

(b) *Sub-plots*

	Mean Yield	
	Clean cwt. per acre	Percentage
Planting:		
Deep ball	4·97 ...	88·6
Deep bare	5·02 ...	89·3
Nursery ball	6·35 ...	113·0
Nursery bare	5·32 ...	94·7
Mean	5·62 ...	100·0
Standard error	·009 ...	·707
Significant Difference, P=·01	·032 ...	·570

This experiment has once again given interesting results confirming those of previous years and stressing the importance of adequate preparation for planting. Holing three months previous to planting is substantially superior to other methods and, similarly, planting with a ball of earth at nursery level. Those plots (table not published) in which the above two treatments were combined gave fifty per cent increase over the mean.

Experiment VII A.—Conversion to Multiple Stem

After taking off the crop on the old growth the latter was cut away and all treatments are now on multiple stem (three uprights). Several of the treatments saved an appreciable crop from being lost during the period of conversion. The results are set out on the next page.

Mean yield—Clean cwt. per acre

	Old	New	Both	Percentage
Clean stump, three suckers	—	0·7	0·7	31·8
Cut off west side primaries, 3 suckers from bottom ...	2·9	0·0	2·9	131·8
Cut off east side primaries, 3 suckers from bottom ...	2·7	1·1	2·9	131·8
Cut off all except top 3 primaries, 3 suckers from bottom	3·5	0·3	3·9	177·3
Agobiada, multiple stem, 3 suckers...	0·0	1·2	1·2	54·5
Top cut at 3 ft. from ground and 3 suckers left to grow at top	2·0	0·1	2·0	90·9
Mean	1·8	0·4	2·2	100·0

Significant difference (P = ·01), cwt = 0·76.
for totals (P = ·01), per cent = 34·54.

Experiment VIII.—Soil Erosion Demonstration

	Mean Yield	
	Clean cwt. per acre	Percentage
(1) Clean Cultivation	3·08	110·4
(2) Contour hedge...	1·68	60·2
(3) Weeds across slope	3·07	110·0
(4) Contour hedge and Procumbent cover crop	2·54	91·0
(5) Banana mulch	2·23	80·0
(6) Procumbent cover crop	3·34	119·7
(7) Erect cover crop	2·04	73·1
(8) Weeds across slope	4·37	156·6
Mean...	2·79	100·0

It is unlikely that further useful results will be obtained from this experiment. Certain of the anti-erosion measures such as weeds across the slope have caused the formation of adequate terraces. This, combined with the fact that trees now cover the ground, should prevent any further erosion.

To summarize briefly the results of the past few years, cover crops and hedges although efficient as anti-erosion measures cannot be adopted under these conditions without irrigation, as they compete harmfully with coffee for the available soil moisture. In the case of plot 7 (*Cannavalia ensiformis*) coffee trees were actually killed. Weeds laid on the contour are very effective and do little damage to the coffee. Banana mulch is adequate as an anti-erosion measure and conserves moisture in the dry season.

Experiment IX.—Methods of Cultivation

Summary of results—1940

	Mean Yield	
	Clean cwt. per acre	Percentage
Fork Jembe	2·60	115·0
Jembe	2·74	121·2
Nil	2·20	97·3
Envelope Forking	1·67	73·9
Trenching	2·11	93·4
Mean	2·26	100·0
Standard error	·34	15·0
Significant difference	1·05	46·5

Mean of three years—1938 to 1940

	Mean Yield	
	Clean cwt. per acre	Percentage
Fork Jembe	2·88	108·4
Jembe	3·00	112·8
Nil	2·74	103·0
Envelope Forking	2·26	85·0
Trenching	2·45	92·1
Mean	2·66	100·0
Standard error	·28	1·07
Significant difference...	·88	3·30

In 1940 and in the mean for a three-year-period no significant differences between the methods of cultivation are reflected in the yields.

Experiment XI.—Kents versus *Bourbon*

Summary of results—1938 to 1940

Clean cwt. per acre

	Kents	Bourbon
1938	7·69	7·12
1939	4·86	3·11
1940	3·70	5·10
Mean	5·41	5·11

Differences are not significant.

Experiment XII.—Selection in Nursery

Summary of results—1940

	Mean Yield	
	Clean cwt. per acre	Percentage
Tops cut back	4·62	98·1
Good roots and good tops	4·40	93·4
Average	4·55	96·6
Good tops and poor roots	5·37	114·0
Poor tops and good roots	4·84	102·8
Poor tops and poor roots	4·51	95·8
Mean	4·71	100·0
Standard error*	·413	8·77

*Does not pass Z test.

The results of this experiment are not significant.

Experiment XIII a, b, c.—Multiple versus *Single Stem.* There are no significant differences to report.

Experiment XIV.—Mulch Experiment

Summary of results—1940

	Mean Yield	
	Clean cwt. per acre	Percentage
(a) Banana mulch (100lb.)	8·57	115·7
(b) Guinea grass mulch (100lb.)	8·42	113·7
(c) *Banana mulch (50lb.) plus S. of A. (½lb.)	6·69	90·3
(d) *Elephant grass (100lb.)	5·67	76·5
(e) Clean weeded	7·48	101·0
(f) Weeds as mulch	7·19	97·1
(g) *Elephant grass (50lb.) plus S. of A. (½lb.)	7·19	97·1
(h) Compost (50lb.) per tree	8·04	108·6
Mean	7·41	100·0
Standard error	·10	1·3
Significant difference P=·05	·29	3·8

*Note that these plots had two years of very harmful cover crop treatments.

Mulching treatments continue to demonstrate their value. In 1940 plots receiving compost (H) have given a significant increase over comparable plots receiving no compost (E); nevertheless compost has not as yet given increases comparable with mulches alone.

This experiment, in the last quarter of the year, showed striking visual evidence of the value of reducing crop when there is clear indication that the trees are going to overbear. It was not possible to reduce crop on the guard rows. As a result there was considerable die-back and cherry scorch. The guard rows stood out clearly as poor yellowish frames round pleasingly green experiment plots. At the same time a good crop matured on the experiment plots in spite of a heavy reduction. These plots promise well for 1941 crop.

Stock

The year has been a disappointing one for stock. Trypanosomiasis broke out in the herd in March and caused the deaths of five animals. After some months of freedom from the disease donkeys became infected in December and two died. Treatment with Congasin saved many animals. Regular blood examinations are now carried out on all stock.

By the kind co-operation of the Tsetse Research Department two skilled "fly" boys made a thorough survey of the neighbourhood. The nearest tsetse caught was near Weru Weru more than three miles away. The actual mechanism of the outbreaks is therefore still unknown and the position is very unsatisfactory.

Eight calves were born during the year including three heifers from the three highest milk yielders. Unfortunately the best cow, which has averaged three hundred gallons of milk for two years, contracted trypanosomiasis and lost her calf. Eight months from calving she has not yet come to service. A fine young bull of hers, serving as stud bull, was also lost. The work of selection has therefore received a serious setback.

At the end of the year the numbers of livestock were as follows : cows 15; heifers and heifer calves 6; oxen and bull calves 13; bulls 2; donkeys 4; = Total 40.

Stock has had grazing in the day time with an allowance of about thirty pounds of elephant grass and/or chopped bananas in the byre. Cows have had in addition about one pound of concentrates consisting of a mixture, as available, of cotton seed, sesame cake, maize meal and bran.

Recorded milking, three times a day, has continued.

Fodder Grasses

The experiment on the times of cutting of elephant grass has not completed an entire cycle. To date the average yearly yield is between thirty-five and forty tons of green fodder per acre. Intervals of about fourteen weeks appear, so far, to be the best times for cutting. The yearly yield of the local guinea grass is about ten tons per acre. A larger type from Mpwapwa shows more promise.

Paddocks

As opportunity occurs paddocks are being laid down and fenced. Three grasses are being tried, *Pennisetum clandestinum* (kikuyu grass), *Pennisetum* sp. and *Cynodom dactylon*. It is possible that the altitude of the station is a little low for kikuyu grass. It does not withstand drought well. The second species of *Pennisetum* grows well in moist areas in valley bottoms and is liked by cattle. The *Cynodon dactylon* is a type introduced from Kabete. It covers the ground well and is fairly drought resistant. Rotational grazing has begun.

Bananas

The area under bananas is gradually being increased. They are grown mainly for mulch. The stems, after being passed through a chaff cutter, are also very palatable to the stock.

In view of the very encouraging results on coffee obtained by the use of banana mulch the following figures are of interest. To purchase mulch from local natives costs Cents 20 per bundle of 50 lb. of dry material. On the station it appears that it can be produced at about half that cost provided supervision is adequate.

Compost

It has not yet been proved, for these conditions, that the gain in yield on plots treated with compost are proportionate to the cost of making and application. However on a low level estate on Meru substantial gains have been obtained in some years.

About two hundred and fifty tons were made at the station this year; most of it from weed growth collected at road sides. About twenty-five tons were made from elephant grass.

After a certain period of growth elephant grass becomes too woody to break down easily. Put through a chaff cutter 6,600 lb. broke down to 1,500 lb. (sixty-eight cubic feet) in four months (a proportion of $4\frac{1}{2} : 1$). A similar quantity stacked at the same time but unchaffed was not ready after five months. If for practical reasons it is impossible to cut the grass at the right time it may well prove best to pass the material through the stock yard as litter. Moreover, in years of light rainfall, it may be more desirable to use the grass direct as mulch. Experiments in hand are adequate to settle these points finally in a year or two.

Lyamungu,
March, 1941

S. M. Gilbert,
Chief Scientific Officer

Appendix I

STATEMENT OF EXPENDITURE FOR THE PERIOD 1st JANUARY TO 31st DECEMBER, 1940

Colonial Development Fund—II. Coffee Research Station

I.—Personal Emoluments

	Provision Shs	Expenditure Shs Cts
1. Chief Scientific Officer		24,000 00
2. Chemist		11,880 00
3. Agricultural Assistant		3,573 00
4. European Clerk		— —
5. Asiatic Clerk		3,681 66
6. Recorders	70,940 00	9,503 69
7. African Laboratory Assistants ...		1,050 00
8. Mechanic		2,640 00
9. African Assistants Mechanic		510 97
10. African Overseer		398 70
11. Messengers		391 30
	70,940 00	57,629 32
Transferred to Item 13 (a)	3,000 00	
	67,940 00	

II.—Other Charges

12. Incidental Expenses :					
(a) Stationery	800	00		252	20
(b) Contingencies				145	87
	800	00	...	398	07
13. Farm Operation and Experimental Work :					
(a) Labour				17,992	95
(b) Field Experiments off Station ...				1,981	93
(c) Upkeep and Maintenance of Transport Vehicles				2,916	85
(d) Maintenance of Power, Gas and Water Plants	32,100	00		2,312	06
(e) Equipment and Materials ...				4,392	11
(f) Books and Periodicals				872	64
(g) Upkeep of Coffee Factory ...				998	30
(h) Upkeep of Stock				975	72
				32,442	56
Outstanding accounts on Crown Agents' Indents				1,913	52
	32,100	00	...	34,356	08
Transferred from Personal Emoluments	3,000	00			
	*35,100	00			

*Shs 28,840 met from Head V.—Agriculture, etc., item 29, Upkeep of Coffee Research Station.

Head V.—Agriculture, Food and Export Control

35. Travelling Allowance	1,000	00	...	652	75
36. Transport Allowance	4,000	00	...	2,018	25
37. Transport	800	00	...	327	07
38. Railway Fares and Freight	1,500	00	...	1,191	33

NOTE.—In addition the salaries and other charges of the Plant Pathologist and the Entomologist are met from departmental funds.

REPORT OF PLANT PATHOLOGIST

I was on duty throughout the year. Until the 10th February I continued the duties of Acting Chief Scientific Officer. After the departure of the Entomologist on military service in June, I supervised the work of the entomological laboratory.

Short safaris were made to the Arusha District in February, June and December, and to an estate in the Usambara Mountains in September. Investigational work has had to be reduced to a minimum, but field experiments have been continued, i.e. treatments have been applied and field data recorded; the latter must await more normal conditions before they can be examined. A short paper entitled "Yellow Bean Mosaic and Notes on other Bean Diseases" was submitted for publication in the *East African Agricultural Journal.*

Coffee

Hemileia.—The spray experiments at Uru have received the treatments applied in previous years. Monthly records of leaf-fall and the crop weights have been noted for future examination.

Leaf-fall.—Control of yellowing and leaf-fall by spraying with Bordeaux mixture has been found necessary in parts of the Arusha District (the ash soils of Ngare-Ol-Motoni and Monduli). Subsequent to local coffee planters having made successful trials with Bordeaux mixture, an experiment was commenced in 1940 to find the minimum requirements for effective control.

In other coffee areas, except at the higher elevations, Hemileia is present and, on Europeans' plantations at least, it is receiving Bordeaux treatment. The problem of the type of leaf-fall just mentioned will therefore arise only in coffee not being treated for Hemileia, and only if the trees require the tonic effects of Bordeaux. At this station abnormally heavy leaf-fall occurred after spraying, apparently as a result of severe drought conditions.

As the experiment has not been under way for a sufficiently long period for precise figures to be recorded, a full description is not necessary at present. The beneficial results from spraying are however confirmed.

Single treatments in February, and double treatments in February and June all show that sprayed trees retain their leaves well during the four months May to August, whereas unsprayed trees suffer considerable leaf-fall. Results from 0·25 per cent Bordeaux are sufficiently close to those from 0·5 per cent to justify its trial by planters. There is as yet no indication of benefit from the second spray in June. Results from a December spray on some plots sprayed in February will be recorded later. Present results from spraying only the upper surface indicate rather less benefit than from spraying the under surface.

A spray solution prepared from "Perenox Dispersable Powder," a cuprous oxide fungicide manufactured by Messrs Imperial Chemical Industries, Limited, London, was used at the rate of 0·55 lb. per thirty-two gallons, i.e. at equivalent cost and two-thirds the copper content of 0·5 per cent Bordeaux mixture. This was as effective as any of the other treatments; it has the added advantage of small bulk, and easy solution. It deserves trial by planters. The fact that cuprous oxide and Bordeaux mixture are equally effective indicates that the copper, and not the sulphur in the latter, is the element which is acting as a tonic to the trees.

The same quantity of Perenox applied as a dust was unsatisfactory. Since only one-ninth of an ounce was used per tree, the fungicide was bulked by the addition of screened wood ash, this being the most inert dust available.

Although crop figures from the experiment cannot yet be given, estate figures show considerable increase of crop from sprayed trees. The encouragement to cropping is such that stripping is essential on sprayed trees.

The November rains failed at Ngare-Ol-Motoni in 1940, and flowering suffered greatly. Counts of trees which were in flower or which had finished flowering in the experiment plots were made on the 12th December; they were: 3 in 64 of the unsprayed (control) trees, 19 in 64 dusted trees, and 20 to 48 (average 34) in lots of 64 trees which received Bordeaux mixture of different strengths. The figure for Perenox solution was 31 in 64. Many flower buds were dead or falling from want of rain.

The indication is that in a dry season, or perhaps more correctly, particularly in a dry season, the benefit to flowering from previous spraying is an additional advantage.

Admittedly some of these results are proving very similar to results already obtained in Kenya, but as local conditions are different, experimental proof of the local spray requirements is necessary.

Sun-scorch.—The term "sun-scorch" is applied to coffee cherries in which one side, usually the upper and western side, has the pulp blackened, flat and shrunken on to the parchment within.

In a mulch experiment at the Coffee Research Station, in which the guard-rows were neither stripped to prevent over-bearing, nor mulched, sun-scorch was severe by November. Trees in which the crop had been reduced by moderate stripping were free from the trouble. The conclusion is that the problem is originally not so much a matter of exposure of cherries to the sun, as their predisposition to scorching. In this case at any rate the principal predisposing cause is weakness induced by over-bearing, and the remedy is stripping.

Associated with the sun-scorch was a distinct yellowing of the foliage, fairly heavy leaf-fall and consequent die-back of twigs.

Beans

Recent observations on French bean diseases have been submitted for publication in the *East African Agricultural Journal.* A non-parasitic sun-scorch is discussed, and also a Yellow bean mosaic. No form of the latter has previously been recorded outside the United States of America so far as can be ascertained from the available literature. The Tanganyika form, first observed in 1940, may or may not be identical with the Yellow bean mosaic described by Pierce in the United States of America; the general symptoms in affected plants are however similar.

The Yellow mosaic in Tanganyika has only been observed in certain introduced American varieties; these were severely attacked and remained stunted and bore small crops. The American form at least is not carried in the seed, and it is concluded that the form observed was already present in the Territory.

Yellow bean mosaic can be distinguished from the much more widely distributed Common bean mosaic. For example, there is a tendency in some leaflets with the former disease to become concave as seen from the upper surface in contrast to the convex leaflets with the Common mosaic.

A small amount of infestation by bean-fly was observed in French beans and cowpeas in June to August. This pest is much more destructive in beans and cowpeas sown at the end of the year.

Burst seed skins.—Each year a proportion of the seeds of French bean varieties show parts of the cotyledons protruding from burst seed skins. The seeds are not damaged as food, but burst skins would spoil the appearance of a consignment for sale. Thirty-nine out of fifty-seven varieties showed damage, the majority only lightly. One variety showed a proportion of 9·3 per cent damaged, another variety 7·2 per cent. No explanation can yet be offered but an experiment to be made in 1941 may indicate the cause.

Bananas

Two diseases requiring investigation are a root disease and a breaking of the stems. The former is caused by an unidentified fungus, which causes a wide network of white mycelium in sections of stem bases. The disease is first recognized by the wilting of the leaves. It has long been known to the native growers on Kilimanjaro under the name "Mkore" and is widely distributed on the mountain; these facts indicate that there is little likelihood of its becoming epidemic, but it is a cause of moderate loss in individual plots. Control will probably be best achieved by propagating only from suckers taken from sound plants in healthy fields.

As fructifications of the fungus have not been seen in the field, they may perhaps be induced in artificial culture, and so render possible the identification of the parasite.

Little is known regarding the other disease, the chief symptom of which is the breaking of the stems. It is not so common, but is sufficiently well known to be recognized by natives under the name "Kichori."

Miscellaneous

A superficial white fungus parasitizing *Pennisetum purpureum* has been identified at the Imperial Mycological Institute, Kew, as *Beniowskia penniseti* (Kalchbr. and Cooke) Mason. The material examined showed this fungus to be overgrown with a species of *Constantinella*. The disease causes yellow or red spotting or complete discolouration of a comparatively small proportion of the leaves.

Scab.—Scab of tea, caused by *Elsinoë Theae* Bitancourt and Jenkins, has been confirmed by Miss Jenkins of the United States Department of Agriculture, Washington, from material collected in the Usambara Mountains. The disease was first recorded in this Territory in 1930, by Dr Storey in Amani tea plants. It is now found to be very common on the older leaves of tea in the Usambaras.

Acknowledgment is made of the assistance rendered on various occasions by the staff of the East African Agricultural Research Station, Amani, and of the Departments of Agriculture in neighbouring colonies.

Among visitors to the laboratory during the year were Dr Boughey and Mr Rayner, Plant Pathologists in the Sudan and Kenya Colony respectively.

Lyamungu, Moshi,
March, 1941

G. B. Wallace,
Plant Pathologist